# Abetong Post-Tensioned, Precast Concrete
# Circular Waste Storage Structure

Owner: Abetong America Incorporated
P.O. Box 1943
North Brunswick, NY 08902
Telephone: 312-729-0646

Local Dealer: Weiser Concrete
W3716 U.S. Hwy. 10
Maiden Rock, WI 54750

Telephone No. 715-647-2311
800-325-8456

Description: Circular, open top, in ground tank comprised of precast wall panels that are placed on a cast in place slab. The panels are tied together with high strength post-tensioning tendons that completely encircle the tank. Grout is placed between the panels before post-tensioning and a closure pour is made around the perimeter at the tank base to provide a watertight vessel.

Designers: Michael Malson, P.E., The Consulting Engineers Group, Inc., 1701 E. Lake Avenue, Glenview, IL 60025, phone 312-729-0646.

Sizes: Variable based on the number of panels used. Ranges are:

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| 8' high | 24.3' thru 90.8' diameter |
| 12' high | 76.5' thru 90.8' diameter |
| 13'–1.5" high | 24.3' thru 74.1' diameter. |

Drawings: Drawings dated 6/8/88. One set of drawings and specifications for 8 ft. high walls and another set that covers both 12 ft. and 13 ft. – 1.5 in. high walls.

Assumptions: Minimum required backfill is governed by frost protection requirements for the foundation slab. Maximum backfill varies according to wall height and tank diameter and is listed on the drawings. Lateral earth pressure of 60 psf (no hydrostatic loads) and lateral wheel surcharge loads of 100 psf are assumed. A maximum allowable backfill height differential of 3 ft. is noted on the plans.

Limitations: Preapproval is subject to the structure being constructed following the approved drawings and specifications and the following limitation. This is to be verified by the certified installer in the form of a letter to the customer.

Welded wire fabric shall not be used in the floor slab. Floor slab reinforcement shall meet the requirements of MN-NRCS Conservation Practice Standard 313, Waste Storage Facility, for applications where liquid-tightness is required. Reinforcement provided shall not be less than the option shown on the drawings of #4 bars @ 18".

Application: NRCS Conservation Practice Standard 313, Waste Storage Facility.

Concurrence: December 8, 1988. The head of the MNTC Engineering Staff concurs in the use of this detail drawing.

## AMERICAN STRUCTURES, INC.

Contractor: American Structures, Inc.
Box 207
Menominee, WI 54751
Telephone: (715) 235-4225

Description: Metal above ground storage tank. Shell consists of used A.O. Smith Harvestore "Slurrystore" glass fused to steel sheets that are bolted together. Footing walls and floor are reinforced concrete. Cathodic protection is provided by zinc anodes electrically connected to the shell, and the floor and footing reinforcement.

Specifications: Specification booklet, "Relocation and Rebuilding Specification for Liquid Manure Storage Tanks", Revised May 1, 2001.

Specification booklet addresses A.O. Smith Harvestore Series 50A, 50B and 90. Consult the specification booklet for the specific sizes covered.

Application: Minnesota NRCS practice standard 313, Waste Storage Facility.

Limitations: Preapproval is subject to the structure being constructed following the approved specification booklet and the following limitations. This is to be verified by American Structures Inc. in the form of a letter to the customer.

Floor slab reinforcement shall meet the requirements of MN-NRCS Conservation Practice Standard 313, Waste Storage Facility, for applications where liquid-tightness is required. Reinforcement provided shall not be less than the option shown in the specification book of #4 bars @ 18". Wire mesh shall not be used in the floor.

Hydrophilic waterstops shall be those approved for use in waste storage facilities as listed in the Hydrophilic Waterstop section of Chapter 17 of the EFH.

Concurrence: September 3, 1996. The state engineer in Wisconsin approved the specification booklet. This approval is adopted by the state engineer in Minnesota.

**ASTLE'S CONCRETE, INC.**

Circular, Site Cast Concrete Waste Storage Structure

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| Owner and Fabricator: | Astle's Concrete, Inc.<br>Henning, Minnesota |
| Designer: | Robert L. Tibbits, P.E.<br>Tibbits Engineering<br>735 11th Street East<br>Glencoe, MN 55336<br>Telephone: (612) 864-5642 |
| Description: | Cast in place, circular, open top, in ground reinforced concrete tank. |
| Drawings: | One Drawing Sheet for each tank size:<br>90'-0" DIA. X 8'-0" DEEP MANURE TANK, Dated 5/5/94<br>105'-0" DIA. X 8'-0" DEEP MANURE TANK, Dated 3/11/94, Rev. 6/6/94<br>125'-0" DIA. X 8'-0" DEEP MANURE TANK, Dated 5/12/94<br>90'-0" DIA. X 12'-0" DEEP MANURE TANK, Dated 6/6/94<br>105'-0" DIA. X 12'-0" DEEP MANURE TANK, Dated 6/6/94<br>125'-0" DIA. X 12'-0" DEEP MANURE TANK, Dated 6/6/94<br>160'-0" DIA. X 8'-0" DEEP MANURE TANK, Dated 5/2/96, Rev. 5/30/96<br>185'-0" DIA. X 8'-0" DEEP MANURE TANK, Dated 5/2/96, Rev. 5/30/96 |
| Sizes: | Diameters: 90, 105, 160, and 185 ft. Wall Heights: 8 and 12 ft |
| Location: | Design notes and plans have been reviewed by the MNTC for compliance with the structural aspects of NRCS Conservation Practice Standard 313. Design folders are on file at the IA and MN state offices. |
| Materials: | The reinforced concrete footings, floor and walls contain Class 3500 concrete and Grade 60 reinforcing steel. |
| Assumptions: | Footings are designed for an allowable soil bearing capacity of 2000 psf (1500 psf for the larger diameter). Walls are designed for tank full, no backfill condition and for full backfill, tank empty condition. The design outside soil load is 60 psf effective fluid pressure plus 100 psf (120 psf for the larger diameter) lateral surcharge. Placement of the tank above the seasonal high water table is assumed. |
| Limitations: | Preapproval is subject to the structure being constructed following the approved drawings and specifications and the following limitation. This is to be verified by the installer in the form of a letter to the customer.<br><br>Welded wire fabric shall not be used in the floor slab. Floor slab reinforcement shall meet the requirements of MN-NRCS Conservation Practice Standard 313, Waste Storage Facility, for applications where liquid-tightness is required. |
| Application: | Minnesota NRCS practice standard 313, Waste Storage Facility. |
| Concurrence: | The Head of the Midwest NTC Engineering Staff concurred in the use of these detail drawings on February 24, 1995, and MN State Conservation Engineer approved the larger (160 and 185 ft) diameter on July 9, 1996. |

**K. Johnson Construction**

Owner: K. Johnson Construction
6870 Hwy 10 NW
Sauk Rapids MN 56379
Telephone: (320) 255-9649

Description: Cast in place, in ground, octagonal reinforced concrete tank. Tank uses cast in place vinyl waterstops.

Sizes: Only available in an 8 ft. depth. Side dimensions range from 22.5 ft. (120,255 gallons) to 90 ft. (2,016,518 gallons). Contact company for standard dimensions that they would have material lists prepared for.

Drawings: One sheet dated 03-18-96 titled, "K. Johnson Construction Waste Storage Structure Standard Design", certified by Alan Vorderbruggen, P.E.

Assumptions: Maximum backfill above footing equals 7'-6". Minimum backfill above footing equals 7'-0". Minimum backfill topwidth equals 8 ft. with a maximum slope in this reach of 8:1. Tank is designed a Frame Tank with a backfill equivalent fluid pressure of 50 psf/ft. This relates to a backfill of "Clean gravel, sand or sand-gravel mixtures (max. 5% fines)" Walls are designed without surcharges except at specified loading areas. Additional reinforcing provided at specified unloading areas.

Limitations: Preapproval is subject to the structure being constructed following the approved drawings and specifications and the following limitation. This is to be verified by the installer in the form of a letter to the customer.

Welded wire fabric shall not be used in the floor slab. Floor slab reinforcement shall meet the requirements of MN-NRCS Conservation Practice Standard 313, Waste Storage Facility for applications where liquid-tightness is required.

Application: Minnesota NRCS practice standard 313, Waste Storage Facility.

Review and Acceptance: Design reviewed and recommended for approval by Des Moines design team on May 16, 1996.

Approval: The Minnesota NRCS state engineer accepted the structure for the pre-approved list on May 24, 1996.

**PAN-L BILT MANURE STORAGE FACILITY**

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| Owner: | Wieser Concrete<br>W3716 U.S. Hwy 10<br>Maiden Rock, WI 54750<br>Telephone: 715-647-2311<br>800-325-8456 |
| Description: | Rectangular, covered, in ground, reinforced concrete tank comprised of precast wall panels keyed into a cast in place floor slab. Precast cover panels and columns. Watertightness provided by compressed mastic strips between wall panels and grouting wall panels into floor slab key. |
| Sizes: | Variable length and width. 8 ft. or 12 ft. wall height. |
| Drawings: | Drawings and specifications are included in the Installation Manual dated April 9, 2001. |
| Assumptions: | Granular backfill with an EFP = 60 psf. Equipment surcharge = 100 psf. Designed for use only with backfill on outside of structure, maximum wall panel exposure is 1 ft. |
| Limitations: | Preapproval is subject to the structure being constructed following the approved drawings and specifications and following limitation. This is to be verified by Wieser Concrete in the form of a letter to the customer.<br><br>Type 1 and Type 2 floors are not approved. The Type 3 floor is approved. |
| Application: | MN NRCS Practice Standard 313, Waste Storage Facility |
| Approval: | April 6, 2000, the State Engineer in Minnesota adopts the structural approval by the State Engineer in Wisconsin (March 20, 2000) and approves the structure for use in Minnesota with the above limitations. The Installation Manual was updated in April 2001. |

**PAN-L-VAT CIRCULAR POST-TENSIONED,**
**PRECAST, AG WASTE STORAGE STRUCTURE**

Owners: Pan-L Tek, LLC
215 South Main St.
Potosi, WI 53820

Contact: Larry Kubly
Telephone: (608) 763-2183
Mobile: (319) 920-0196

Description: Circular, above ground, open topped, prestressed concrete tank with sprayed on interior PVC membrane. Wall footing and base slab are cast-in-place concrete. The tank walls are precast concrete double-T sections. Prestressing tendons (hoop tendons) are threaded around the tank circumference (through the wall panels) and post-tensioned at buttress style jacking panels equally spaced on the circumference. A full-height gasket seals the joint between wall panels. A pour strip at the base of the wall (to accommodate radial movement during tendon stressing) is filed with non-shrink grout and a compressible joint filler. The joint filler is sealed with polyurethane.

Drawings: Two sheets, drawing numbers S-1 and S-2, dated 1/24/00, certified by Martin Mikula, P.E.

Sizes: Structures range in size from 50 ft to 200 ft in diameter in 10 ft increments, and from 10 ft to 20 ft in height.

Assumptions: Design conditions, Material Requirements, General Conditions for Construction, and Quality Assurance requirements are all listed on sheet one of the drawings.

- The required bearing capacity of soil under footings is 4,000 psf or greater. Plans require four to eight soil borings. A six inch layer of compacted sand is required under base slab.
- Required backfill height is four feet above top of footing and must be at a uniform level around the tank. Backfill shall be free-draining (<50% fines) and exert an equivalent fluid pressure of 60 psf or less. Greater depth of backfill requires confirming calculations by the tank designer which is not included in this pre-approval.
- Wall footing and base slab shall be constructed above the groundwater table.
- No equipment is mounted to the tank wall. A transport vehicle adjacent to the tank during loading and unloading is anticipated. The surcharge from the vehicle shall not exceed the equivalent of 2 ft. of backfill.

Limitations: Preapproval is subject to the structure being constructed following the approved drawings and specifications. This is to be verified by the installer in the form of a letter to the customer.

Application: Minnesota NRCS practice standard 313, Waste Storage Facility.

History and Acceptance: The Panel-L-Vat was originally designed in 1981 by Ray Crammond. It was reviewed approved by the MNTC in August 1981. The tank was redesigned in 1996 by Martin Mikula. Redesign was accepted by Iowa NRCS in February 2000. Minnesota NRCS adopted Iowa NRCS's acceptance in March 2000.

**PATZ SALES INC.,**
**REINGORCED CONCRETE AG WASTE STORAGE STRUCTURES**

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| Owners: | Patz Sales, Inc.<br>P.O. box 7<br>Pound, WI 54161-007<br>Telephone: (920) 897-2251 |
| Designer: | Milton A. Nero, P.E.<br>DePere, WI |
| Description: | Cast in place kidney shaped stacking slab intended as a reception structure for direct discharge from a pivoting manure stacker. Structure is not considered to be liquid tight. |
| Drawings: | Patz Solid Manure Storage Plans and Specifications for Construction of Concrete Holding Areas for Above-Ground Storage and Manure dated (as revised) May 1983, (document #PA-2052 1.5M Rev. 5/83) consisting of 15 numbered sheets plus cover sheet. |
| Sizes: | Varying from 90' centerline length and 42' in width (44' manure stacker) to 120' centerline length shuttles on wall top) and vary in height from 3' to 8', and typically are backfilled to half-height. |
| Location: | Design notes and plans have been reviewed by the MNTC for compliance with the structural aspects of Conservation Practice Standard 313, Waste Storage Facility. |
| Materials: | Walls, footings and floors are site cast with Class 3000 concrete and Grade 60 steel. |
| Assumptions: | Walls designed for tank both empty and full of waste with soil backfill to wall half-height. Soil effective fluid pressure is 65 psf/ft, waste EFP is 60 psf/ft. Allowable soil bering pressure is 2000 psf. The floor beyond the footing length is non-structural, containing only welded wire fabric to control cracking. |
| Limitations: | Preapproval is subject to the structure being constructed following the approved drawings and specifications and the following limitation. This is to be verified by the installer in the form of a letter to the customer.<br><br>The footing details shown on sheets 5, 9, and 13 <u>are not approved</u>. The approved footing detail is depicted on sheet 15. |
| Application: | MN NRCS practice standard 313, Waste Storage Facility. |
| Concurrence: | The Head of the Midwest NTC Engineering Staff concurs in the use of these detail drawings except as noted above. |

**ENGINEERED STORAGE PRODUCTS COMPANY**
**SLURRYSTORE STRUCTURE MODELS**

Designer and Fabricator: Engineered Storage Products Company
345 Harvestore Drive
Dekalb, IL 60115-9646
Telephone: (815) 756-1551

Description: Metal above ground storage tank. Shell consists of glass fused to steel sheets that are bolted together. Footing walls and floor are reinforced concrete. Cathodic protection is provided by zinc anodes electrically connected to the shell and the floor and footing reinforcement.

Model Number And Sizes: Each structure is furnished with a name plate that identifies the model number, structure size (diameter and height), and a serial number as follows:

| Slurrystore Model Number | Structure I.D. Ft - in | Structure Height Ft - in |
|---|---|---|
| 90A-4214 | 41’-11 9/16” | 14’-2 11/16” |
| 90A-4219 | 41’-11 9/16” | 18’-9 11/16” |
| 90A-4223 | 41’-11 9/16” | 23’-4 11/16” |
| 90A-4228 | 41’-11 9/16” | 27’-11 5/8” |
| 90A-6214 | 61’-6 ½” | 14’-2 11/16” |
| 90A-6219 | 61’-6 ½” | 18’-9 11/16” |
| 90A-6223 | 61’-6 ½” | 23’-4 11/16” |
| 90A-6228 | 61’-6 ½” | 27’-11 5/8” |
| 90A-7009 | 69’-11 1/8” | 9’-7 11/16” |
| 90A-7014 | 69’-11 1/8” | 14’-2 11/16” |
| 90A-7018 | 69’-11 1/8” | 18’-9 11/16” |
| 90A-7023 | 69’-11 1/8” | 23’-4 11/16” |
| 90A-8114 | 81’-1 ½” | 14’-2 11/16” |
| 90A-8119 | 81’-1 ½” | 18’-9 11/16” |
| 90A-8123 | 81’-1 ½” | 23’-4 11/16” |
| 90A-8128 | 81’-1 ½” | 27’-11 5/8” |
| 90A-10114 | 100’-8 ½” | 14’-2 11/16” |
| 90A-10119 | 100’-8 ½” | 18’-9 11/16” |
| 90A-10123 | 100’-8 ½” | 23’-4 11/16” |
| 90A-10128 | 100’-8 ½” | 27’-11 5/8” |
| 90A-12010 | 120’-3 ½” | 9’-7 11/16” |
| 90A-12014 | 120’-3 ½” | 14’-2 11/16” |
| 90A-12019 | 120’-3 ½” | 18’-9 11/16” |
| 90A-12023 | 120’-3 ½” | 23’-4 11/16” |
| 90A-12028 | 120’-3 ½” | 27’-11 5/8” |

| Slurrystore Model Number | Structure I.D. Ft - in | Structure Height Ft - in |
|---|---|---|
| 96A-5010 | 50’-4 13/16” | 9’-7 11/16” |
| 96A-5014 | 50’-4 13/16” | 14’-2 11/16” |
| 96A-5019 | 50’-4 13/16” | 18’-9 11/16” |
| 96A-5910 | 58’-9 11/16” | 9’-7 11/16” |
| 96A-5914 | 58’-9 11/16” | 14’-2 11/16” |
| 96A-5919 | 58’-9 11/16” | 18’-9 11/16” |
| 96A-7010 | 70’-0” | 9’-7 11/16” |
| 96A-7014 | 70’-0” | 14’-2 11/16” |
| 96A-7019 | 70’-0” | 18’-9 11/16” |
| 96A-7810 | 78’-4 7/8” | 9’-7 11/16” |
| 96A-7814 | 78’-4 7/8” | 14’-2 11/16” |
| 96A-7819 | 78’-4 7/8” | 18’-9 11/16” |
| 96A-9510 | 95’-2 ½” | 9’-7 11/16” |
| 96A-9514 | 95’-2 ½” | 14’-2 11/16” |
| 96A-9519 | 95’-2 ½” | 18’-9 11/16” |
| 96A-11210 | 112’-0 1/8” | 9’-7 11/16” |
| 96A-11214 | 112’-0 1/8” | 14’-2 11/16” |
| 96A-11219 | 112’-0 1/8” | 18’-9 11/16” |
| 96A-12310 | 123’-2 9/16” | 9’-7 11/16” |
| 96A-12314 | 123’-2 9/16” | 14’-2 11/16” |
| 96A-12319 | 123’-2 9/16” | 18’-9 11/16” |
| 96A-14010 | 140’-0 3/16” | 9’-7 11/16” |
| 96A-14014 | 140’-0 3/16” | 14’-2 11/16” |
| 96A-14019 | 140’-0 3/16” | 18’-9 11/16” |

DRAWINGS AND INSTALLATION MANUAL:

Design Assumptions: The shell design assumes above ground application only. Footing strength design is based on a foundation bearing capacity of 2000 psf or greater and a minimum 3000 psi concrete strength. The final concrete floor slab reinforcement will be determined by the installer based on the tank diameter to be constructed. Most slabs will be reinforced to allow a monolithic pour.

Limitations: Preapproval is subject to the structure being constructed following the approved drawings and specifications. This is to be verified by the certified installer in the form of a letter to the customer.

Application: Minnesota NRCS Practice Standard 313 Waste Storage Facility.

Concurrence: The State Conservation Engineer in Illinois has concurred in an independent review performed by a consultant that the structural design is in accordance to NRCS Standard 313. This concurrence is adopted by the State Conservation Engineer in Minnesota.

Comments: The use of used materials is approved for these structures with the following conditions:

1. The tank must be installed by an Engineered Storage Products Company authorized dealer.
2. All items embedded in concrete must be new.
3. The installation meets the current installation manual.
4. The manufacturer provides the same warranty as they do on a new tank.
5. The used panels will be inspected and damaged areas will be repaired in accordance with the manufacturer's recommendations. Severely bent or damaged panels shall be rejected.

**NRCS MAINTAINED PLANS**

IA 900 Circular Concrete Manure Tank

Description: Cast in place, open top, circular, reinforced concrete tank. Design reviewed and plans completed by NRCS, Des Moines, IA design team based on Midwest Plan Service publication TR-9, "Circular Concrete Manure Tanks Using a Hinged-base, Free-top Design."

Drawings: Iowa NRCS standard drawing No. IA 900, dated 5/99. Drawings are available as CAD drawing file names Tr9sht1.dwg andTr9sht2.dwg. CADD drawings available on IA NRCS home page www.ia.mn.usda.gov under Engineering and then CADD Drawings

Sizes: Diameters of 30 feet to 120 feet in 15 feet increments. Heights of 8, 10, 12, 14 feet.

Assumptions: Soil backfill loads: 85 psf/ft. EFP with no surcharge or 60 psf/ft. EFP with 120 psf lateral surcharge. No minimum backfill. Maximum backfill is 6" from top of tank. Backfill shall be brought up uniformly around the tank. The maximum difference in the finished backfill elevations around the tank shall be 3 feet.

Hydrophilic or nonmetallic waterstops or sand blasted surfaces used to provide water tightness in all joints.

Minnesota 8 ft Deep Concrete Tank

Description: Cast in place, rectangular, reinforced concrete tank with beams and columns. Tank can be open top or covered. Design based on Midwest Plan Service Publication 36, "Concrete Manure Storages Handbook."

Drawings: Two sheets dated 10/98. CADD drawings available on Minnesota NRCS home page www.mn.nrcs.usda.gov under Resources Information, Engineering and then CADD drawings.

Sizes: Infinite length and width. Depth of 8 ft.

Assumptions: Assumptions are listed on the drawings. Wall soil loading is 85 psf/ft based on backfill with low to medium plasticity silts and clays lacking in sand and gravel, CL or ML. Wall loading also assumes a 100 psf vertical surcharge on the backfill.

**OLDER NRCS PLANS FOR AG WASTE STORAGE**

Drawing Nos. 5,E-33,001 and 5,E-33,002
Rectangular cast in place tank with beams
Sizes: 4'- 20' width by 4'- 12'depth, any length
MNTC Approval: 4-11-74

Notes: Can be built for a coarse grained backfill (EFP=65psf/ft.) or fine grained backfill (EFP=100psf/ft.) plus a 100psf surcharge for either condition.

Watertable – designed for submergence partway up the wall. Therefore, the floor is a structural slab and the footings are extended for buoyancy.

Backfill – minimum 2/3 of tank depth on all four sides

Drawing No. 5,E-31,326
Circular cast in place reinforced concrete tank with cast in place top with center column.
Sizes: 32 ft. and 48 ft. diameter, depths of 6 ft., 8 ft., or 10 ft.
WNTC Approval: 12-72

Notes: Backfill – designed for fine grained backfill (EFP=100 psf/ft.) plus a 100psf.

Watertable – designed for 3.75 ft. of submergence. Therefore the floor is a structural slab.

Cover slab is designed for 60 psf live load. It is not designed to support a loaded manure trailer, wagon or truck.

Drawing No. 5,E-34,434
Circular cast in place reinforced concrete tank with cast in place top with center column.
Sizes: 32 ft. and 48 ft. diameter, depths of 6 ft., 8 ft., or 10 ft.
WNTC Approval 2-74

Notes: Backfill – Designed for fine grained backfill (EFP=100 psf/ft.) plus a 100 psf.

Watertable – designed for 3.75 ft. of submergence. Therefore the floor is a structural slab.

Cover slab is designed for 150 psf live load. Cover is designed to support two 8,000 lb wheel loads.